CLAIMS

1. A nucleic acid delivery construct and a payload, wherein the nucleic acid delivery construct comprises at least one sense or antisense RNA subdomain of the human cytomegalovirus β2.7 RNA, wherein each subdomain is capable of localization within the mitochondria.

2. The nucleic acid delivery construct and payload of claim 1, wherein the RNA sequences from human cytomegalovirus β2.7 RNA has a sequence identity of 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% of one or more of the RNA sequences selected from the group consisting of β2.7 RNA (SEQ ID NO: 1 or SEQ ID NO: 2), domain 1 (D1; SEQ ID NO: 3 or SEQ ID NO: 7) of β2.7 RNA, domain 2 (D2; SEQ ID NO: 4 or SEQ ID NO: 8) of β2.7 RNA, domain 3 (D3; SEQ ID NO: 5 or SEQ ID NO: 9) β2.7 RNA, domain 4 (D4; SEQ ID NO: 6 or SEQ ID NO: 10) of β2.7 RNA and combinations thereof.

3. The nucleic acid delivery construct and payload of claim 1 or claim 2, wherein the RNA sequences from human cytomegalovirus β2.7 RNA are selected from the group consisting of β2.7 RNA (SEQ ID NO: 1 or SEQ ID NO: 2), domain 1 (D1; SEQ ID NO: 3 or SEQ ID NO: 7) of β2.7 RNA, domain 2 (D2; SEQ ID NO: 4 or SEQ ID NO: 8) of β2.7 RNA, domain 3 (D3; SEQ ID NO: 5 or SEQ ID NO: 9) of β2.7 RNA, domain 4 (D4; SEQ ID NO: 6 or SEQ ID NO: 10) of β2.7 RNA and combinations thereof.

4. The nucleic acid delivery construct and payload of claim 3, wherein the RNA sequences from human cytomegalovirus β2.7 RNA comprise sequences selected from the group consisting of the full length sequence of β2.7 RNA (SEQ ID NO: 1 (sense)), the full length sequence of β2.7 RNA (SEQ ID NO: 2 (antisense)), domain 1 of β2.7 RNA (SEQ ID NO: 3 (sense)), domain 1 of β2.7 RNA (SEQ ID NO: 7 (antisense)), domain 2 of β2.7 RNA (SEQ ID NO: 4 (sense)), domain 2 of β2.7 RNA (SEQ ID NO: 8 (antisense)), domain 3 of β2.7 RNA (SEQ ID NO: 5 (sense)), domain 3 of β2.7 RNA (SEQ ID NO: 9 (antisense)), domain 4 of β2.7 RNA (SEQ ID NO: 6 (sense)), and domain 4 of β2.7 RNA (SEQ ID NO: 10 (antisense)).

5. The nucleic acid delivery construct and payload of claim 3, wherein the RNA sequence from human cytomegalovirus β2.7 RNA comprises domain 2, domain 3 and domain 4 of β2.7 RNA (SEQ ID NO: 11 (sense) or SEQ ID NO: 40(antisense)); or domain 1, domain 3 and domain 4 of β2.7 RNA (SEQ ID NO: 12 (sense) or SEQ ID NO: 41 (antisense)); or domain 1, domain 2

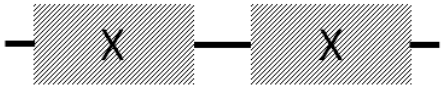
and domain 4 of β2.7 RNA (SEQ ID NO: 13 (sense) or SEQ ID NO: 42 (antisense)); or domain 1, domain 2 and domain 3 of β2.7 RNA (SEQ ID NO: 14 (sense) or SEQ ID NO: 43 (antisense)).

6. The nucleic acid delivery construct and payload of any one of claims 1 to 5, wherein the nucleic acid delivery construct comprises at least one spacer sequence.

7. The nucleic acid delivery construct and payload of claim 6, wherein if the nucleic acid delivery construct comprises at least two spacer sequences, at least one spacer sequence is at the 5' end and at least one another spacer sequence is at the 3' end of the RNA sequence from human cytomegalovirus β2.7 RNA.

8. The nucleic acid delivery construct and payload of claim 6 or claim 7, wherein the at least one spacer sequence is selected from the group consisting of S1a (SEQ ID NO:27), S1b (SEQ ID NO:28), S2a (SEQ ID NO:29), S2b (SEQ ID NO:30), S3a (SEQ ID NO:31), S3b (SEQ ID NO:32), S4a (SEQ ID NO:33), S4b (SEQ ID NO:34), S6a (SEQ ID NO:35), S6b (SEQ ID NO:36), S8a (SEQ ID NO:37), S8b (SEQ ID NO:38) and Spacer F3A (SEQ ID NO: 39); and/or optionally, wherein the spacer sequence comprises a stop codon.

9. The nucleic acid delivery construct and payload of claim 3, wherein each RNA sequence is selected from the group consisting of domain 1 (D1; SEQ ID NO: 3 or SEQ ID NO: 7), domain 2 (D2 SEQ ID NO: 4 or SEQ ID NO: 8), domain 3 (D3; SEQ ID NO: 5 or SEQ ID NO: 9) and domain 4 (D4; SEQ ID NO: 6 or SEQ ID NO: 10) of β2.7 RNA, according to formula I:

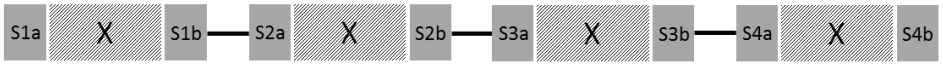


(I)

wherein each X is independently selected from the group consisting of D1 (SEQ ID NO: 3 or SEQ ID NO: 7), D2 (SEQ ID NO: 4 or SEQ ID NO: 8), D3 (SEQ ID NO: 5 or SEQ ID NO: 9), D4 (SEQ ID NO: 6 or SEQ ID NO: 10) or combinations thereof, including duplicates, triplicates, quadruplicates, quintuplicates, sextuplicates, septuplicates, octuplicates, or longer repeats of single domains; and wherein each X is optionally preceded or followed or flanked by at least one or more spacer sequences as defined in any one of claims 6 to 8.

10. The nucleic acid delivery construct and payload of claim 3, wherein the RNA sequence from human cytomegalovirus β2.7 RNA is a tetramer of a RNA sequences, wherein each RNA

sequence is selected from the group consisting of domain 1 (D1; SEQ ID NO: 3 or SEQ ID NO: 7), domain 2 (D2 SEQ ID NO: 4 or SEQ ID NO: 8), domain 3 (D3; SEQ ID NO: 5 or SEQ ID NO: 9) and domain 4 (D4; SEQ ID NO: 6 or SEQ ID NO: 10) of β2.7 RNA, according to formula II:

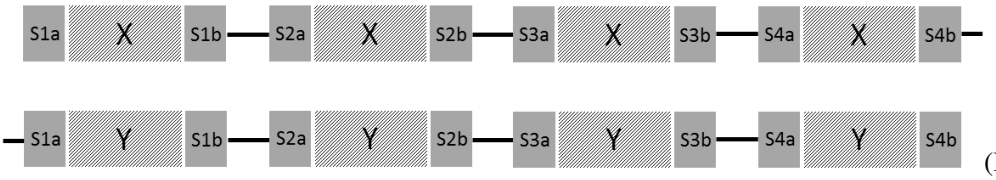


(II)

wherein each X is independently selected from the group consisting of D1 (SEQ ID NO: 3 or SEQ ID NO: 7), D2 (SEQ ID NO: 4 or SEQ ID NO: 8), D3 (SEQ ID NO: 5 or SEQ ID NO: 9), D4 (SEQ ID NO: 6 or SEQ ID NO: 10) or combinations thereof, including duplicates, triplicates, quadruplicates, quintuplicates, sextuplicates, septuplicates, octuplicates, or longer repeats of single domains; and wherein the spacer sequences S1a, S1b, S2a, S2b, S3a, S3b S4a and S4b are as defined in claim 8.

11. The nucleic acid delivery construct and payload of claim 10, wherein each X is D2 (SEQ ID NO: 4 or SEQ ID NO: 8); or wherein each X is D3 (SEQ ID NO: 5 or SEQ ID NO: 9); or wherein the nucleic acid delivery construct comprises a nucleic acid sequence according to SEQ ID NO: 15 or SEQ ID NO: 52 or wherein the nucleic acid delivery construct comprises a nucleic acid sequence according to SEQ ID NO: 16 or SEQ ID NO: 53.

12. The nucleic acid delivery construct and payload of claim 3, wherein the RNA sequence from human cytomegalovirus β2.7 RNA is an octamer of a RNA sequences selected from the group consisting of domain 1 (D1; SEQ ID NO: 3 or SEQ ID NO: 7), domain 2 (D2; SEQ ID NO: 4 or SEQ ID NO: 8), domain 3 (D3; SEQ ID NO: 5 or SEQ ID NO: 9) and domain 4 (D4; SEQ ID NO: 6 or SEQ ID NO: 10) of β2.7 RNA, according to formula III:



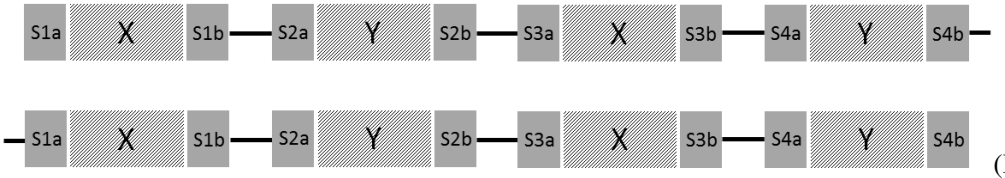
(III)

wherein X and Y are different from each other, wherein each X and each Y are independently selected from the group consisting of D1 (SEQ ID NO: 3 or SEQ ID NO: 7), D2 (SEQ ID NO: 4 or SEQ ID NO: 8), D3 (SEQ ID NO: 5 or SEQ ID NO: 9), D4 (SEQ ID NO: 6 or SEQ ID NO: 10) or combinations thereof, including duplicates, triplicates, quadruplicates, quintuplicates, sextuplicates, septuplicates, octuplicates, or longer repeats of single domains;

and wherein the spacer sequences S1a, S1b, S2a, S2b, S3a, S3b S4a and S4b are as defined in claim 8.

13. The nucleic acid delivery construct and payload of claim 12, wherein X is D3 (SEQ ID NO: 5 or SEQ ID NO: 9) and Y is D2 (SEQ ID NO: 4 or SEQ ID NO: 8); or wherein X is D2 (SEQ ID NO: 4 or SEQ ID NO: 8) and Y is D3 (SEQ ID NO: 5 or SEQ ID NO: 9); or wherein the nucleic acid delivery construct comprises a nucleic acid sequence according to SEQ ID NO: 17 or SEQ ID NO: 54; or wherein the nucleic acid delivery construct comprises a nucleic acid sequence according to SEQ ID NO: 18.

14. The nucleic acid delivery construct and payload of claim 3, wherein the RNA sequence from human cytomegalovirus β2.7 RNA is an octamer of a RNA sequences selected from the group consisting of domain 1 (D1; SEQ ID NO: 3 or SEQ ID NO: 7), domain 2 (D2; SEQ ID NO: 4 or SEQ ID NO: 8), domain 3 (D3; SEQ ID NO: 5 or SEQ ID NO: 9) and domain 4 (D4; SEQ ID NO: 6 or SEQ ID NO: 10) of β2.7 RNA, according to formula IV:



(IV)

wherein X and Y are different from each other, wherein each X and each Y are independently selected from the group consisting of D1 (SEQ ID NO: 3 or SEQ ID NO: 7), D2 (SEQ ID NO: 4 or SEQ ID NO: 8), D3 (SEQ ID NO: 5 or SEQ ID NO: 9), D4 (SEQ ID NO: 6 or SEQ ID NO: 10) or combinations thereof, including duplicates, triplicates, quadruplicates, quintuplicates, sextuplicates, septuplicates, octuplicates, or longer repeats of single domains; and wherein the spacer sequences S1a, S1b, S2a, S2b, S3a, S3b S4a and S4b are as defined in claim 8.

15. The nucleic acid delivery construct and payload of claim 14, wherein X is D3 (SEQ ID NO: 5 or SEQ ID NO: 9) and Y is D2 (SEQ ID NO: 4 or SEQ ID NO: 8); or wherein the nucleic acid delivery construct comprises a nucleic acid sequence according to SEQ ID NO: 19.

16. The nucleic acid delivery construct and payload of any one of claims 1 to 15, wherein the nucleic acid delivery construct comprises a sequence according to any one of SEQ ID NO: 20

to SEQ ID NO:84.

17. A vector, a recombinant cell, or a recombinant organism comprising the nucleic acid delivery construct of any one of claims 1 to 16.

18. The recombinant cell or the recombinant organism of claim 17, wherein the nucleic acid delivery construct is expressed constitutively or not constitutively.

19. A nucleic acid sequence comprising at least one or more sense or antisense RNA sequences of the human cytomegalovirus β2.7 RNA selected from group consisting of domain 1 (Dl; SEQ ID NO: 3 or 7), domain 2 (D2; SEQ ID NO: 4 or 8), domain 3 (D3; SEQ ID NO: 5 or 9) and domain 4 (D4; SEQ ID NO: 6 or 10).

20. Use of the nucleic acid delivery construct and payload of any one of claims 1 to 16 in the manufacture of a medicament for treating a mitochondrial disorder, wherein the payload comprises a nucleic acid molecule.

21. The use of claim 20, wherein the nucleic acid delivery construct and payload enhances mitochondrial gene function, or suppresses defective mitochondrial gene function, or both (provided that in this case the mitochondrial genes are different from each other), wherein the mitochondrial gene functions are different from each other.

22. The use of claim 21, wherein the payload comprises an antisense RNA.

23. The use of claim 21 or claim 22, wherein the mitochondrial disorder is selected from the group consisting of maternally inherited diabetes mellitus, Leber's hereditary optic neuropathy (LHON), neuropathy, ataxia, retinitis pigmentosa, myoclonic epilepsy with ragged red fibres (MERRF), mitochondrial myopathy encephalopathy lactic acidosis and stroke like symptoms (MELAS), Parkinson's disease, chronic obstructive pulmonary disorder (COPD), Kearns-Sayre Syndrome (KSS), Pearson Syndrome and progressive opthalmoplegia (PEO).

24. The use of claim 21 or claim 22, wherein the mitochondrial disorder is to be treated by targeting at least one affected (mitochondrial) gene selected from the group consisting of MT-TL1 (tRNA leucine), MT-ND1, MT-ND4, MT-ND6, MT-ATP6, MT-TK (tRNA lysine), MT-ND1, MT-

ND5, MT-TH (histidine), MT-TL1 (leucine), MT-TV (valine), and combinations thereof.